HETEROSIS AND COMBINING ABILITY FOR GRAIN YIELD AND SOME RELATED CHARACTERS IN RICE (*Oryza sativa* L.)

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ABSTRACT

This research was carried out at the Experimental Farm, Faculty of Agriculture, Kafr El-Sheikh, Tanta University.The aim of the experiment was to study heterosis and combining ability for the most important traits of rice (heading date, plant height, number of productive tillers/plant, panicle length, number of fertile grains/ panicle, fertility percentage, 1000-grain weight, main panicle weight and grain yield/plant). Six rice cultivars (five local; Sakha 101, Sakha 102, Giza 172, Giza 178 and Reiho; and one Russian, Vangar) were crossed in one half diallel cross in 1999 season. These parents and their respective 15 F_1 crosses were grown in a randomized complete block design in 2000 season. **The most important results of this experiment were summarized as follows:**

1- Highly significant differences were found among the studied genotypes. Also, general (GCA) and specific (SCA) combining abilities were highly significant for all studied traits.

2- The best general combiners for earliness and short stature were Vanger and Giza 178, while the best general combiners for grain yield/plant and one or more of its attributes were Sakha 101 and Sakha 102.

3- The results of heterosis, as a percentage of mid-parent coupled with SCA effects revealed that Sakha 101 × Reiho, Sakha 102 × Giza 172 and Giza 172 × Giza 178 crosses were the top performing ones for most traits, so they could be recommended to be utilized in hybrids breeding programs.

4- The GCA/SCA ratio revealed the importance of additive gene effect in the inheritance of all traits, expect for heading date and fertility percentage, where their non- additive gene action was more essential.

INTRODUCTION

Rice is an important cereal crop in Egypt. There is a need for increasing the Egyptian national production of rice for local consumption and for exportation. The aim of a rice-breeding program is to breed new high yielding rice cultivars, which posses many essential characteristics to fulfill the national requirements. Early maturity and short stature are

the most important characters. Early maturity is important because it will increase the chance of having one more cut Egyptian of clover in Egypt. Breeding for short stature cultivars appears to be a very considerable objective as the traditional rice cultivars are not suitable for mechanical harvesting because of lodging before harvest. This, in turn, causes a high percentage of losses during the traditional harvesting practices.
Exploitation of heterosis in self- pollinated crops, especially rice, is not yet feasible. Further, exploitation of heterosis depends mainly on general and specific combining abilities of genotypes in the hybrids.
The diallel analysis provides a very useful information to plant breeders in making decisions, concerning the type of breeding system and selecting breeding materials that show the greatest promise for successful selection. This method was developed by Griffing (1956) and was recommended by several research workers dealing with self-pollinated crops (El-Hissewy and El-Kady, 1992; El-Hity, 1992 and Abd El-Aty, 2000).

The objectives of this study were to 1: Evaluate six local and exotic rice genotypes, as well as their 15 F_1 diallel crosses, and to identify the superior cultivars and cross combinations. 2: Determine the potentiality of heterosis expression for some agronomic and grain yield related characters, and 3: Estimate the combining ability effects and the mode of gene action in the inheritance of grain yield and some related agronomic traits.

MATERIALS AND METHODS

The present study was conducted at the Experimental Farm, Faculty of Agriculture, Kafr El-Sheikh, Tanta University, Egypt, during 1999 and 2000 summer growing seasons. Six rice cultivars; namely, Sakha101, Sakha 102, Giza 172, Giza 178,Vangar (Russian) and Reiho were crossed in all possible combinations excluding the reciprocals in 1999.During 2000 season, all the 15 F_1's and their six parents were grown in a randomized complete block design, with three replications, spaced at 25 cm among rows and 20 cm among plants. Recommended cultural practices were followed .The studied characters were: heading date (days), plant height (cm), number of productive tillers/plant, panicle length (cm), number of fertile grains/panicle, fertility percentage, 1000-grain weight (g) and main panicle weight (g). Heterosis was calculated as the percentage of increase over both mid- parent ($\overline{MP}$) and better-parent (B.P) of each cross as follows:

Heterosis (%) over mid-parent=F_1-$\overline{MP}$/ $\overline{MP}$ × 100
Heterosis (%) over better parent=F_1-BP/ BP × 100
The data were analyzed by using Griffing (1956) method (2) model (1) to estimate the general combining ability (G.S.A.) and specific combining ability (S.C.A.) effects. The cultivars were considered fixed. The relative importance of GSA to SCA were expressed as follows:

$$\frac{K^2 \text{ G.C.A}}{K^2 \text{ S.C.A.}} = \frac{\text{Ms G.C.A. - Ms e} / (P + 2)}{\text{Ms S.C.A. - Ms e}}$$

Where: Ms = mean squares, e = error term, P = No. of parents and K^2 = the average squares of the effects.

RESULTS AND DISCUSSION

Analysis of variance:

In the present study, the mean squares of genotypes were highly significant for all characters. Both general and specific combining abilities, effects were highly significant for all characters. This indicates the importance of both additive and non-additive genetic effects in determining the performance of these characters (Table 1).

1. Mean performance:

Mean performances of the parents and F_1 hybrids are presented in Table (2). A wide range of performance among the parental cultivars was shown. Also, significant differences were detected among the F_1 hybrids for all characters. Vangar was the earliest cultivar (about 83 days) and had the shortest plants (around 90 cm). While, Sakha 101 and Sakha 102 were superior in grain yield/ plant (about 40 and 39 g/ plant, respectively) compared to the other cultivars (ranging from around 31 to 38 g/ plant)

All F_1 crosses, except two were earlier than their parental means. As regard the plant height, twelve of the F_1 crosses were taller than their parental means. Four crosses out of fifteen had higher number of productive tillers/ plant and five crosses had the tallest panicle length, compared to their parents. Furthermore, ten crosses had higher number of fertile grains/panicle and ten crosses were superior in 1000-grain weight The main panicle weights of F1 all crosses were higher than their parental means. Concerning the grain yield/plant thirteen crosses out of fifteen were higher than their parental means.

Table (1): Mean squares of general combining ability (G.C.A.) and specific combining ability (S.C.A.) and their ratios for the studied characters.

S.O.V.	d.f.	Heading date (days)	Plant height (cm)	No. of productive tillers/plant	Panicle length (cm)	No. of fertile grains/ panicle	Fertility (%)	1000-grain weight (g)	Main panicle weight (g)	Grain yield/ plant (g)
Genotypes	20	63.61**	138.92**	5.35**	1.576**	326.39**	18.73**	110.08**	0.160**	31.33**
G.C.A.	5	174.20**	517.99**	17.38**	4.590**	1176.76**	17.77**	20.77**	0.471**	113.90**
S.C.A.	15	26.67**	12.56**	1.34**	0.572**	42.94**	19.05**	1.81**	0.057**	3.81**
Error	40	0.366	1.71	0.105	0.062	0.505	0.619	0.060	0.003	0.129
G.C.A/S.C.A.		0.82	5.39	1.66	1.03	3.43	0.12	1.45	1.05	3.78

** Significant at 0.01 level of probability.

Table (2): Mean performances of the 15 F_1 diallel crosses and their parents for the studied characters.

Genotypes	Heading date (days)	Plant height (cm)	No. of productive tillers/plant	Panicle length (cm)	No. of fertile grains/ panicle	Fertility (%)	1000-grain weight (g)	Main panicle weight (g)	Grain yield /plant (g)
Sakha 101	98.27	93.33	22.00	18.23	115.97	88.99	26.13	2.77	39.58
Sakha 102	95.47	104.67	20.33	16.53	127.07	86.97	27.73	2.70	39.13
Giza 172	103.33	118.33	22.20	16.73	108.67	89.57	23.17	2.19	32.79
Giza 178	95.93	95.00	21.20	18.00	134.33	86.33	21.13	2.53	38.45
Vangar	82.87	90.33	17.87	15.80	98.53	80.53	25.33	2.17	30.75
Reiho	101.63	101.67	20.93	16.13	98.03	88.98	25.57	2.21	31.87
Sakha 101 × Sakha 102	93.37	100.00	22.47	16.27	124.33	88.21	27.56	2.79	39.58
Sakha 101 × Giza 172	95.13	106.33	21.47	17.07	120.33	86.33	26.80	2.83	38.30
Sakha 101 × Giza 178	92.33	97.67	21.73	17.07	124.67	92.41	25.27	2.83	39.83
Sakha 101 × Vangar	93.00	97.33	18.17	15.93	113.67	90.12	26.40	2.66	34.93
Sakha 101 × Reiho	93.13	102.33	22.47	16.67	117.67	89.14	25.85	2.80	37.87
Sakha 102 × Giza 172	96.73	113.67	21.07	17.07	121.00	86.35	25.23	2.72	39.57
Sakha 102 × Giza 178	91.20	103.33	20.67	17.87	127.33	87.24	24.63	2.78	39.37
Sakha 102 × Vangar	87.87	102.00	18.87	16.07	118.67	87.91	25.47	2.66	35.09
Sakha 102 × Reiho	97.10	103.00	20.93	16.13	119.73	88.85	25.63	2.74	36.73
Giza 172 × Giza 178	93.47	107.33	20.87	17.73	125.00	88.48	23.70	2.64	38.58
Giza 172 × Vangar	91.47	105.33	19.00	16.43	102.66	91.07	25.13	2.32	31.85
Giza 172 × Reiho	94.27	108.00	20.93	16.40	102.20	88.77	25.77	2.32	32.69
Giza 178 × vangar	90.67	92.67	19.87	16.27	118.27	90.76	24.13	2.47	35.39
Giza 178 × Reiho	95.27	99.67	20.47	16.93	115.40	91.28	25.03	2.58	36.01
Vangar × Reiho	87.43	97.33	19.33	15.93	100.67	86.86	25.83	2.27	30.97
L.S.D. 0.05	0.99	2.15	0.53	0.41	1.39	1.29	0.40	0.09	0.99
0.01	1.33	2.88	0.71	0.54	1.86	1.73	0.53	0.10	1.32

2. Effects of heterosis :

Data in Tables (3) and (4) represented the heterotic effects for the different studied characters. Significant and highly significant positive heterosis percentages, over both mid- and better parents were obtained in most cases. Highly significant negative heterosis values were observed for earliness in seven of the fifteen crosses. The earliest crosses were Sakha 101 × Reiho and Giza 172 × Reiho. Positive heterosis, also, was highly significant for number of productive tillers/plant in the crosses, Sakha 101 × Sakha 102 and Sakha 101 × Reiho. Two crosses showed a highly significant heterosis percentages for panicle length; namely, Giza 172 × Giza 178 and Sakha 102 × Giza 172. The best three crosses in number of fertile grains/panicle were Sakha 101 × Giza 172, Vangar × Reiho and Sakha 101 × Reiho. With regard to fertility percentage, four of the fifteen crosses were found to be more fertile than their respective better parent (Table 4). Highly significant heterosis for 1000-grain weight was found in five crosses, in comparison with their better parents (Table 4).

Concerning the main panicle weight twelve crosses showed highly significant increase than their respective better parent (Table 4). Also two crosses showed highly significant heterosis percentage for grain yield per plant. Sakha 102 × Giza 178 and Sakha 101 × Giza 178 (Table 4). Vendenberg and Matzinger (1970) indicated that heterosis over better parents could be a better measure for breeding purpose. Accordingly, the best crosses, Sakha 101 ×Giza 178 and Sakha 102 × Giza 178, were identified for improving rice grain yield and some of its component trait (Table 4).

3. Combining ability effects:

Table (1) presents the mean square values among F_1 hybrids. The data revealed that there were highly significant differences among entries For all studied traits, and indicated that there were highly significant estimates for both general and specific combining ability effects.

GCA/SCA ranged between 0.12 – 5.39. This indicates that both additive and non-additive components of genetic variance were important in the inheritance of these characters. General combining ability was more important than SCA for plant height, number of fertile grains/panicle, 1000-grain weight, main panicle weight, panicle length and grain yield/ plant (Table 1). These results suggest a predominant role of additive type of gene action for these traits and selection for them

Table (3): Heterosis as a percentage of mid-parent (MP) for the studied characters for the diallel crosses of rice.

Crosses	Heading date (days)	Plant height (cm)	No. of productive tillers/ plant	Panicle length (cm)	No. of fertile grains / panicle	Fertility (%)	1000-grain weight (g)	Main panicle weight (g)	Grain yield/ plant (g)
Sakha 101 ×Sakha 102	-3.61**	1.01	6.14**	-6.39**	2.31**	0.26	2.34**	1.82**	0.56*
Sakha 101 × Giza 172	-5.63**	0.47	-2.85**	-2.35**	7.13**	-3.30**	8.72**	14.11**	5.83**
Sakha 101 × Giza 178	-4.91**	3.72**	-1.25**	-5.79**	-0.384	5.41**	6.94**	6.79**	2.08**
Sakha 101 × Vangar	2.68**	5.99**	-8.88**	-6.11**	5.99**	7.17**	2.60**	7.69**	-0.68*
Sakha 101 × Reiho	-6.82**	4.95**	4.66**	-2.97**	9.97**	0.17	0.00	12.45**	5.99**
Sakha 102 × Giza 172	-2.69**	1.95*	-0.94**	6.25**	2.66**	-2.18**	-0.86**	11.02**	10.03**
Sakha 102 × Giza 178	-4.70**	3.50**	-0.48*	3.47**	-2.58**	0.68	0.82**	6.11**	1.49**
Sakha 102 × Vangar	-1.46**	4.62**	-1.2**	-0.62*	5.20**	4.97**	-3.99**	9.02**	0.43
Sakha 102 × Reiho	-1.87**	-0.16	1.45**	-1.22**	6.38**	0.99	-3.10**	11.38**	3.47**
Giza 172 × Giza 178	-6.18**	0.62	-3.82**	2.07**	2.88**	0.60	6.99**	11.86**	8.16**
Giza 172 × Vangar	-1.75**	0.95	-5.19**	0.98**	-0.91	7.08**	3.63**	6.42**	0.25
Giza 172 × Reiho	-8.01**	-1.82	-2.97**	-0.18	-1.11*	-0.57	-2.86**	5.45**	1.11**
Giza 178 × vangar	1.42**	0.00	1.69**	-3.73**	1.58**	8.79**	3.87**	5.11*	2.28**
Giza 178 × Reiho	-3.55**	1.35	-2.85**	-0.82**	0.67	4.01**	7.19**	8.86**	2.42**
Vangar × Reiho	-5.22**	1.39	-0.36	-0.25	2.43**	2.48**	1.49**	3.65**	-1.09**

*, ** Significant at 0.05 and 0.01 levels of probability, respectively.

Table (4): Heterosis as a percentage of better-parent (HP) for the studied characters for the diallel crosses of rice.

Crosses	Heading date (days)	Plant height (cm)	No. of productive tillers/ plant	Panicle length (cm)	No. of fertile grains/ panicle	Fertility (%)	1000-grain weight (g)	Main panicle weight (g)	Grain yield/ plant (g)
Sakha 101 ×Sakha 102	-2.20**	7.15**	2.14**	-10.75**	-2.16**	-0.88	-0.25	0.72**	0.00
Sakha 101 × Giza 172	-3.20**	13.93**	-3.29**	-6.36**	3.36**	-3.62**	2.56**	2.17**	-3.23**
Sakha 101 × Giza 178	-3.57**	4.65**	-1.23**	-6.36**	-7.77**	3.84**	-3.29**	2.17**	0.63*
Sakha 101 × Vangar	12.22**	7.75**	-17.41**	-12.61**	-1.98**	1.27	1.03**	-3.97**	-11.75**
Sakha 101 × Reiho	-5.23**	9.64**	2.14**	-8.56**	1.47*	0.17	-1.07**	1.08**	-4.32**
Sakha 102 × Giza 172	1.31	8.60**	-5.09**	2.03**	-4.78**	-3.59**	-9.02**	0.74**	0.01
Sakha 102 × Giza 178	-4.47**	8.77**	-2.5**	-0.72**	-5.21**	0.31	-11.18**	2.96**	0.61*
Sakha 102 × Vangar	6.03**	12.92**	-7.18**	-2.78**	-6.61**	1.08	-8.15**	-1.48**	-10.32**
Sakha 102 × Reiho	1.71**	1.31	0.00	-2.42**	-5.78**	-0.15	-7.57**	1.48**	-6.13**
Giza 172 × Giza 178	-2.56**	12.98**	-5.99**	7.26**	-6.95**	-1.22	2.29**	4.35**	0.21
Giza 172 × Vangar	10.38**	16.61**	-14.41**	-8.72**	-5.53**	1.67*	-0.79**	5.94**	-2.87**
Giza 172 × Reiho	-7.24**	6.23**	-5.72**	-1.97**	-5.95**	-0.89	0.78**	4.98**	-0.30
Giza 178 × vangar	9.41**	2.59*	-6.22**	-2.75**	-11.96**	6.60**	-4.74**	-2.37**	-7.96**
Giza 178 × Reiho	-0.69	4.92**	-3.44**	-5.94**	-14.09**	2.58**	-2.11**	1.98**	-6.35**
Vangar × Reiho	5.50**	7.75**	-5.26**	-1.24**	2.17**	-2.38**	1.06**	2.71**	-2.82**

*, ** Significant at 0.05 and 0.01 levels of probability, respectively.

could be successful in the segregating generations. The additive gene action was found to be of great importance by El-Hissewy (1985); El-Hity (1992); El-Keredy et al. (1992 a&b) and Dora *et al.* (1999).

On the other hand, S.C.A was higher than that of G.C.A. for heading date and fertility percentage (Table 1). These results suggest that the genetic variations among entries for such traits were mainly due to non-additive gene action. In some earlier studies, dominance was more important than additive gene actions, as reported by Khaleque *et al.* (1978); Aly *et al.* (1981) and Sarathe and Singh (1986). Other rice investigators showed that both additive and non- additive gene actions were equally important in the inheritance of such characters (Kou and Liu, 1986 and Peng and Virmani, 1990).

A- General combining ability effects: The general combining ability effects, given in Table (5), revealed that the parents, Vangar and Giza 178, were good general combiners for earliness. Whereas, Vangar, Giza178 and Sakha 101 genotypes were the best donors for short stature. Vangar and Giza 178 showed negative and significant estimates for number of days to heading and plant height. Such negative G.C.A. effects revealed that one or more of these cultivars might be the best general combiners for earliness and short stature to improve plant type. Sakha 101 and Giza 172 showed the highest significant positive effects of G.C.A. for number of productive tillers/plant. Concerning the panicle length, the two cultivars, Giza 178 and Sakha 101 showed highly significant positive and desirable G.C.A. effects. Giza 178, Sakha 102 and Sakha 101 showed highly significant positive G.C.A. effects for number of fertile grains/panicle. The cultivars Sakha 101 and Sakha 102 proved to be excellent combiners for grain yield / plant. This is of practical interest in a breeding program towards developing high yielding genotypes because of their superiority in main panicle weight and 1000-grain weight. Also, Giza 178 that was superior in number of fertile grains/ panicle (Table 5)

B- Specific combining ability effects: Estimates of specific combining effects from F_1 hybrids are shown in Table (6). S.C.A. for heading date was negative and highly significant in nine crosses. The best cross combinations for earliness were Vangar × Reiho, Sakha 101 × Reiho and Giza 172 × Reiho, which indicated that one of these combinations could be helpful for selecting early maturing rice lines. For plant height, two crosses (G. 172 × Reiho and G. 178 × Vangar) showed negative and highly significant desirable S.C.A effects. Only two crosses exhibited

Table (5): Estimates of general combining ability effects for traits of six rice parents.

Parents		Heading date (days)	Plant height (cm)	No. of productive tillers/ plant	Panicle length (cm)	No. of fertile grains /panicle	Fertility (%)	1000-grain weight (g)	Main panicle weight (g)	Grain yield /plant (g)
Sakha 101		0.857**	-2.847**	0.750**	0.297**	2.650**	0.684**	0.926**	0.182**	2.055**
Sakha 102		0.070	2.278**	0.062	-0.078	6.725**	-0.788**	0.826**	0.138**	1.959**
Giza 172		2.636**	8.028**	0.429**	0.135**	-2.858**	0.304*	-0.552**	-0.096**	-0.823**
Giza 178		-0.230*	-2.806**	0.213**	0.597**	8.492**	0.639**	-1.544**	-0.039**	1.653**
Vangar		-5.060**	-4.722**	-1.667**	-0.607**	-7.550**	-1.366**	0.031	-0.152**	-2.939**
Reiho		1.728**	0.069	0.213*	-0.344**	-7.458**	0.517**	0.314**	-0.110**	-1.905**
$SE_{(gi)}$	0.05	0.228	0.492	0.121	0.095	0.267	0.296	0.093	0.020	0.136
	0.01	0.304	0.658	0.160	0.127	0.357	0.396	0.124	0.027	0.181
L.S.D. $_{(gi-gj)}$	0.05	0.353	0.763	0.188	0.146	0.414	0.459	0.143	0.035	0.219
	0.01	0.472	1.020	0.252	0.195	0.554	0.613	0.191	0.047	0.279

*, ** Significant at 0.05 and 0.01 levels of probability, respectively.

Table (6): Specific combining ability effects for the studied characters in six parents of diallel crosses of rice.

Crosses	Heading date (days)	Plant height (cm)	No. of productive tillers/ plant	Panicle length (cm)	No. of fertile grains/ panicle	Fertility (%)	1000-grain weight (g)	Main panicle weight (g)	Grain yield/ plant (g)
Sakha 101 ×Sakha 102	-1.366**	-1.304	1.040**	-0.680**	-0.956*	-0.086	0.465**	-0.098**	-0.606**
Sakha 101 × Giza 172	-2.166**	-0.720	-0.327	-0.092	4.627**	-3.048**	1.086**	-0.176**	0.892**
Sakha 101 × Giza 178	-2.100**	1.446*	0.157	-0.555**	-2.389**	2.700**	0.544**	0.038	-0.050
Sakha 101 × Vangar	3.397**	3.030**	-1.531**	-0.484**	2.652**	2.418**	0.103	0.055	-0.359*
Sakha 101 × Reiho	-3.257**	3.238**	0.890**	-0.013	6.561**	-0.448	-0.081	0.154**	1.540**
Sakha 102 × Giza 172	0.221	1.488*	-0.039	0.283*	1.219**	-1.563**	-0.381**	0.111**	2.255**
Sakha 102 × Giza 178	-2.445**	1.988**	-0.223	0.620**	-3.798**	-1.012**	0.011	0.032	-0.121
Sakha 102 × Vangar	-0.949**	2.571**	-0.143	0.024	3.577**	1.663**	-0.731**	0.103**	-0.110
Sakha 102 × Reiho	1.497**	-1.220	0.044	-0.171	4.552**	0.720	-0.847**	0.138**	0.503**
Giza 172 × Giza 178	-2.745**	0.238	-0.389*	0.274*	3.452**	0.150	0.456**	0.126**	1.657**
Giza 172 × Vangar	0.084	0.155	-0.377**	0.179	-2.839**	3.741**	0.314*	0.00	-0.565**
Giza 172 × Reiho	-3.903**	-1.970**	-0.323	-0.117	-3.398**	-0.438	0.664**	-0.041	-0.759**
Giza 178 × Vangar	2.151**	-1.679*	0.707**	-0.451**	1.411**	3.102**	0.306*	0.075*	0.503**
Giza 178 × Reiho	-0.037	0.530	-0.573**	-0.046	-1.548**	1.733**	0.922**	0.077*	0.082
Vangar × Reiho	-3.044**	0.113	0.173	0.158	-0.239	-0.679	0.147	-0.039	-0.366**
SE (Sii) 0.05	0.625	1.352	0.334	0.258	0.735	0.814	0.252	0.061	0.306
0.01	0.836	1.807	0.447	0.345	0.982	1.087	0.337	0.081	0.409
L.S.D. (Sii-Skl) 0.05	0.865	1.868	0.462	0.356	1.015	1.124	0.349	0.083	0.513
0.01	1.156	2.497	0.617	0.476	1.357	1.503	0.466	0.111	0.685

*, ** Significant at 0.05 and 0.01 levels of probability, respectively.

positive and highly significant desirable S.C.A. effects for number of productive tillers/plant (Sakha 101 × Reiho and G. 178 × Vangar). Concerning panicle length, only one cross (Sakha 102 × G.178) showed positive and highly significant S.C.A. effects. Eight out of the fifteen cross combinations showed positive and highly significant desirable S.C.A. effects for number of fertile grains/panicle. With regard to fertility percentage, six crosses showed positive and highly significant S.C.A effects. For 1000-grain weight, eight of the fifteen crosses exhibited positive and either significant or highly significant S.C.A. values. Seven crosses showed significant and highly significant positive S.C.A. effects for main panicle weight, the best combinations were Sakha 101 × Reiho and Sakha 102 × Reiho.

Furthermore, the estimates of S.C.A. effects were positive and highly significant for grain yield / plant in six crosses. The highest positive values were estimated for Sakha 102 × Giza 172 followed by Giza 172 × Giza 178 then, Sakha 101 × Reiho. These results indicate that the non-additive genetic effects were more predominant in these particular combinations of rice crosses for grain yield / plant.

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الملخص العربى

قوة الهجين والقدرة على الائتلاف لمحصول الحبوب وبعض الصفات المرتبطة به فى الأرز

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أجرى هذا البحث بالمزرعة البحثية لكلية الزراعة بكفراللشيخ– جامعة طنطا لدراسة قوة الهجين والقدرة على الائتلاف لستة أصناف من الأرز، خمسة منها محلية وهى: سخا١٠١، سخا ١٠٢، جيزه ١٧٢، جيزه ١٧٨، وريهو وصنف روسى (فنجر)، وقد أجريت كل التهجينات الممكنة بين هذه الآباء والتى أدت الى الحصول على خمسة عشر هجينا (فيما عد الهجن العكسية) وذلك فى الموسم ١٩٩٩، وفى الموسم الثانى (٢٠٠٠) تمت زراعة الأباء والهجن الناتجة منها باستخدام تصميم القطاعات الكاملة العشوائية فى ثلاث مكررات وكانت الصفات المدروسة هى: تاريخ طرد النورات، ارتفاع النبات، عدد الأشطاء حاملة النورات، طول النورة، عدد الحبوب الخصبة فى النورة، النسبة المئوية للخصوبة، وزن الألف حبه، وزن النورة الرئيسية بالإضافة الى محصول الحبوب بالنبات.

ويمكن تلخيص أهم النتائج فيما يلى:

١– وجدت اختلافات عالية المعنوية بين التراكيب الوراثية المدروسة، وكانت تقديرات القدرة العامة والقدرة الخاصة على الائتلاف عالية المعنوية لجميع الصفات المدروسة.

٢– كان الصنفان "سخا ١٠١و سخا ١٠٢" أحسن الأباء للقدرة العامة على الائتلاف لمحصول الحبوب وواحدة أو أكثر من الصفات الأخرى، بينما كان الصنفان "فنجر وجيزه ١٧٨" من أفضل الأصناف من حيث التبكير وقصر النبات.

٣– كانت قوة الهجين لمتوسط الابوين والقدرة الخاصة على الائتلاف عالية المعنوية لمعظم الصفات المرغوبة فى الهجن "سخا ١٠١ × ريهو و سخا ١٠٢ × جيزه ١٧٢ و جيزه ١٧٢ × جيزه ١٧٨" ولهذا يمكن استخدامها كهجن مبشرة فى تحسين محصول الحبوب فى برامج تربية الأرز.

٤– أوضحت نسبة القدرة العامة الى القدرة الخاصة على الائتلاف أهمية الفعل الجينى المضيف فى وراثة جميع الصفات المدروسة فيما عدا صفتى التزهير والنسبة المئوية للخصوبة، فكان الفعل الجينى غير المضيف لهما أكثر أهمية.